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Karema on account of the hostility of the natives. He descended the Luapula for some distance, and found that, as shown in Ravenstein's map of Eastern Equatorial Africa, this river flows out of the south-west side of Lake Bangweolo.——Dr. Pogge died at St. Paolo de Loanda on March 17th.——The bay of Angra Pequeña, 27° N. lat., on the coast of Great Namaqua land, has recently been taken possession of by Germany. It is curious that upon the maps, even on those of the Germans themselves, this spot is marked as belonging to England.——Robert Flegel continues his explorations of the Niger and the Benua. While waiting for funds, he joined the Swiss explorer, Zweifel, in a voyage upon the lower course of the Niger. This exploration has given us a map of the Niger and its affluent the Amambara. On his return to the coast M. Flegel found himself able to continue his work, and reached Loko on September 11th.

GEOLOGY AND PALÆONTOLOGY.

OBSERVATIONS ON THE PHYLOGENY OF THE ARTIODACTYLA DERIVED FROM AMERICAN FOSSILS.[1]—I have maintained[2] that the Selenodont dentition is a derivation of the bunodont, a proposition which seems unavoidable from a mechanical point of view. The testimony of palæontology is also in its favor since in America the oldest Artiodactyle, Pantolestes, is Bunodont. Kowalevsky, in the phylogenetic table given in his monograph of Anthracotherium[3] does not commit himself as to this point, but allows the development of the two types of dentition to appear to have been contemporary and from some common origin. He then derives from such a common point of departure, first, the Hyopotamidæ, which first appeared in the Eocene, and second, the ancestors of Anoplotheriidæ. From the Hyopotamidæ he derives all the modern Selenodonta, exclusive of the Camelidæ. The latter group he omits from his table, doubtless because his information on the subject was insufficient. The main line of origin of the Selenodonta is divided early in the Miocene time, the genus Gelocus giving origin to the Pecora, and the genus Hyæmoschus to the Tragulina.

In describing the characters of the genus Poëbrotherium for the first time, I remarked as follows:[4] "The present genus is a more generalized type than Gelocus, and in its distinct trapezoid and distinct metacarpals represents an early stage in the developmental history of that genus. It also presents affinity to an earlier type than the Tragulidæ which sometimes have the divided metacarpals, but the trapezoïdes and magnum coössified. In fact Poëbrotherium as direct ancestor of the camels, indicates that the existing Ruminantia were derived from three lines represented by the genera Gelocus, for the typical forms, Poëbrotherium for the camels, and Hyæmoschus for the Tragulidæ."

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[1] Portion of a paper read before the Amer. Asso'n Adv. Science, Phila., 1884.

[2] Journal Academy Nat. Sciences, Phila., 1874.

[3] 1873 (? 4), p. 152.

[4] Bulletin U. S. Geol. Surv. Terrs., Vol. 1, No. 1, p. 16, Jan., 1874.

These views being then established on sufficient evidence, it remains to make such additions as the facts cited in the first part of this paper indicate. First in importance comes the place in the phylogeny of the Selenodonta, of the Oreodontidæ. The peculiar inward extension of the unciform bone already ascribed to them, characterizes also among extinct forms the genus Leptomeryx, and probably Hypertragulus. Among recent ruminants it is only seen in the Tragulidæ.[1] If we arrange these types in serial order we find the modifications of forms to be generally identical with those of the other ruminant lines, in the coössification of the bones of the legs and feet. This series may then be regarded as phylogenetic. The peculiar structure of the carpus of the Oreodontidæ puts them out of the question as ancestors of any type of existing ruminants other than the Tragulina. Whether they themselves can be traced to a five-lobed, or to a four-lobed bunodont ancestor, remains an undecided question. It is not, however, probable that a five-lobed form has been intercalated in a series, both of whose extremities are four-lobed. If this be true, the Oreodontidæ must be regarded as an ancestral type of Selenodonta, coëqual with the Hyopotamidæ, and it may well be questioned whether the latter can have been ancestors of the existing Ruminantia, whose molars are four-lobed.

So the present investigation does not disclose the ancestral stock of the Pecora. In North America we have not progressed further in the solution of this question than I reached in 1877,[2] after a study of the genera Cosoryx Leidy, and Blastomeryx Cope. I had already[3] suggested that the former genus is the ancestor of the Cervidæ, but subsequently[4] remarked "it is not probable that this genus is the immediate ancestor of Cervus, from the fact that the molar teeth display in their prismatic form a higher degree of specialization than belongs to that genus. It is probable that the true ancestor combined the dental type of Cervus with the distinct roots and short crowns of the molars, with the type of horns here described." I at that time included a species (*Cosoryx gemmifer* Cope), in the genus provisionally, which has the type of molars in question. Having discovered another larger species which has the same type of molars, I at once distinguished the provisional group in which I had placed the *C. gemmifer*, Blastomeryx, as a genus, and in describing the species (*B. borealis*) observed as follows: "In brief, its molars differ from those of Cosoryx (" Dicrocerus ") as much as those of the deer differ from the molars of the antelope. While Cosoryx (" Dicrocerus") was probably the ancestor of Antilocapra, Blastomeryx was the ancestor of Cervus or Cariacus." This opinion expresses all the information I possess on the subject at present. It remains to ascertain the structure of the anterior feet in Hypisodus, which is the earliest genus of Ruminantia known to have prismatic molars.

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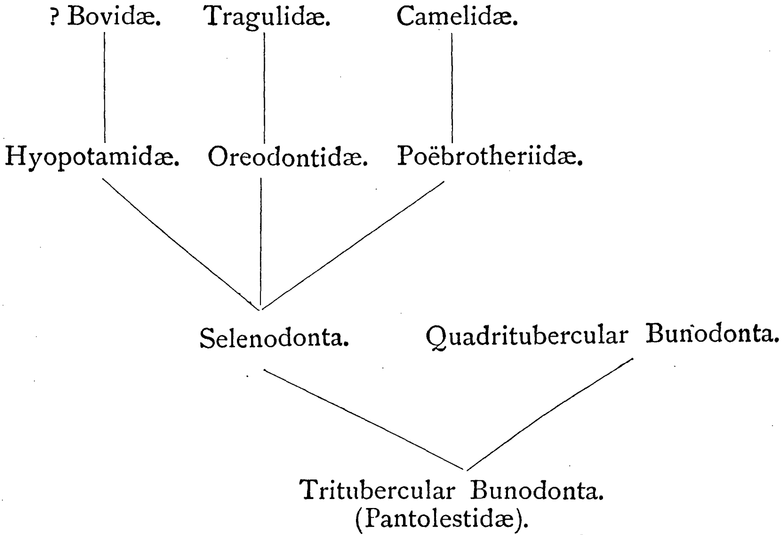
[1] Among Perissodactyles it occurs in Tapirus and the Rhinocerontidæ.

[2] Proceedings Amer. Philos. Soc., p. 223.

[3] Proceed. Acad. Phil., 1874, p. 149.

[4] Report Expl. and Surv. W. of 100th Merid. U. S., Geo. M. Wheeler in charge, IV, pl. II, p. 349, 1877.

The following table will represent the views expressed in the preceding pages:



—*E. D. Cope.*

Eruption of Krakatoa.—It will be remembered, says *Science Gossip*, that the Dutch government appointed a commission to investigate the nature and results of the eruption of Krakatoa, in August last. The report has just been presented by Dr. Verbeck, and it is a remarkable illustration of scientific courage and adventure. At the same time it shows that the eruption was on a scale which might almost be called catastrophic. Krakatoa lies on a rent or fissure in the crust of the earth which runs across the Straits of Sunda. Dr. Verbeck thinks that sea-water may have been admitted thus to the molten matter beneath, so as to form steam at high pressure. The sound of the volcanic explosion of August last was heard over a space equal to one-sixth of the earth's circumference. So violent were the air waves caused by the explosion, that walls were rent by them (not by earthquakes) at the distance of 830 kilometers away. One air-wave was propelled from Krakatoa which traveled no less than three and a quarter times round the circumference of the earth. The large tidal wave appears to have been caused by the northern part of the mountain giving way. There only remains the southern part, which has been cut in two from the very top, and forms on the north side a magnificent precipitous cliff more than 2500 feet high. In the place where the fallen part once stood there is now everywhere deep sea, in some places as much as 1000 feet deep. The ashes thrown out by the eruption must have been enormous, especially if we are correct in assuming that the brilliant sunsets are due to the finer parts suspended in the atmosphere. Within a circle of fifteen kilometers' radius from the mountain, the layers of volcanic ashes thus ejected cover the ground from sixty to eighty meters thick. The known surface over which the ashes were ejected, as calculated by Dr. Verbeck, is 750,000 square kilometers, apart from other unknown areas where they also descended. He thinks that the finer particles, propelled by the wind, have made a journey round the world. The vapor was condensed to water, and froze in the cold currents. The refraction through these innumerable ice crystals, Dr. Verbeck thinks, caused the beautiful and red glows of our phenomenal sunsets. He calculates that the quantity of solid substances ejected by the volcano was eighteen cubic kilometers. Dr. Verbeck and his staff thoroughly explored the island last October, when the heat was so great as almost to stifle them.

THE SEVENTH VOLUME OF THE GEOLOGICAL SURVEY OF ILLINOIS commences with a description of the coal measures by A. H. Worthen. The coal fields occupy 3600 square miles, and contain sixteen seams, five of which can be profitably mined at some points. At a depth of 682 feet a deposit of coal oil has been found at Litchfield. Messrs. Orestes St. John and A. H. Worthen contribute descriptions of the carboniferous fossil fishes. As many as sixty-three Cochliodontidæ are described, of which some fifty-seven are new, comprising the new genera Vaticinodus, Stenopterodus, Chitonodus, Deltodopsis, and Orthopleurodus. Thirteen species of Psammodontidæ are characterized, eleven of which are new. The teeth of the Psammodontidæ form a pavement akin to that of Myliobates, but each tooth is quadrangular or trapezoidal. Ichthyorodulites conjectured to belong to twenty-two forms, mostly new, are also described. The volume concludes with descriptions of the carboniferous invertebrates, by A. H. Worthen, S. A. Miller and others. Thirty-seven species of Poteriocrinus, and eighteen other crinoids, are enumerated. Messrs. Wachsmuth and Harris describe *Heteroschisma gracile*, a new genus and species of Blastoidæ, and two other species of Blastoids. The Asteroidea are enriched by the addition of *Compsaster formosus* and *Cholaster peculiaris;* the Ophiuroidea by *Tremataster difficilis*, and the Echinoidea by *Hybochinus spectabilis*, a new Peristodomus and three species of Archæocidaris. Only eleven molluscan species are given.

GEOLOGICAL NOTES. — *General.*—The age of the formations around Keff, in Tunis, has been determined by M. Maris by the aid of the fossils. There is a regular superposition of upper cretaceous, eocene and miocene. The middle eocene, or nummulitic beds, rest directly upon the Senonian or chalk, without the interposition of a lower eocene. The uppermost part of the cretaceous is very rich in fossils, especially in small echini related to Faujasia, and may belong to the Darian stage. The most interesting of the lower beds are those which enclose *Heterocerus polyplocum*, and correspond to the upper Senonian beds of Tercis, in Westphalia, and to the chalk of Meddon.

Tertiary.—M. Dieulafait's conclusions regarding the origin of the phosphorites and ferruginous clays of France are as follows:

(1) The quantity of phosphate of lime existing in the caverns of the south-west of France does not represent a tenth part of that which existed in the limestones, the removal of which produced the caverns.

(2) The ferruginous clays, which accompany and often cover the phosphates, have the same composition as those which are obtained by attacking with a feeble oxydating acid, the rocks constituting the walls of the phosphorite caverns.

(3) Rare substances, such as manganese, nickel, cobalt, zinc, copper, and iodine, which exist in the normal rocks of the phosphorite districts, are found in a relative state of concentration in the phosphorites and in their accompanying clays.

These results point to the possibility that the phosphorites of the calcareous plateaux of the south-west of France have, for the most part, if not entirely, been extracted from the encasing rocks, solely by the influence of the chemical reactions of the humid method.

MINERALOGY.[1]

ALLANITE, APATITE AND TYSONITE CRYSTALS.—Professor E. S. Dana[2] has given careful crystallographic descriptions of allanite from Moriah, N. Y., apatite from Paris, Me., and tysonite from Colorado. The crystal of allanite was remarkable both for size and perfection, measuring 3¾ by 4½ inches, having smooth planes and being of a symmetrical shape.

The apatite crystal, of a deep blue color, was small (¼ inch in length), but beautifully modified. It was doubly terminated by pyramids of the third order, these hemihedral forms being unusually prominent. Two new planes for the species were ascertained.

The crystal of tysonite was the largest yet found, weighing fully two and a half pounds. Only a few planes were observed, but the

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Amer. Journ. Sc.*, 1884.